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UNIVERSITY OF ALBERTA

META-ANALYSIS OF WILDLIFE BENEFIT ESTIMATES IN A CANADIAN CONTEXT

BY

BONNIE CHAREEN RUSH

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE**

IN

FOREST ECONOMICS
DEPARTMENT OF RURAL ECONOMY

EDMONTON, ALBERTA
FALL 1995

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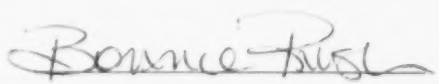

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October 6, 1995

ABSTRACT

In this study, meta-analytical techniques are used to synthesize and provide generalized results on past wildlife benefit reports. The survey questions that appear in these reports are analyzed to explain the variability of the benefit values.

The data for the analysis were derived from a database created for the Alberta Fish and Wildlife Division, which included 53 wildlife and wildlife-related studies performed in Alberta, other Canadian provinces, and a number of northern states in the USA. Twenty-five studies, providing 92 wildlife benefit values, were chosen for the analysis. Then, linear and log linear OLS regression models tested the variability of these values.

The OLS regression tested the following variables to explain variations in the wildlife benefit estimates: (a) substitute sites, (b) method of estimation, (c) study origin, (d) type of study conducted, (e) open-ended questions, (f) willingness to pay, and (g) data year. The linear OLS regression model provided three significant variables (substitute sites, willingness to pay, and consumptive hunting). The log linear OLS regression model provided four significant variables (substitute site, fishing, hunting, and willingness to pay), which influenced the wildlife benefit estimates.

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CHAPTER I
INTRODUCTION

A. The Use of Wildlife and Wildlife-Related Values

Since the early 1970s, there has been a major focus on the value of wildlife and recreation. Increasingly, these values have been incorporated into wildlife management decisions. Perhaps the most common applications of wildlife values in management decisions occur in litigation and court cases, and they are used for assessing fines for illegally-taken game. They also help to determine the real and positive effects on local communities that depend upon their wildlife assets. Most recently, wildlife values have been used to determine benefit transfers between regions that are similar in environment.

Benefit transfer is the developing art of estimating the demand for wildlife and recreation in new or revised areas by using existing information on sites having similar physical and/or ecological qualities. Reference data can be derived from within the country under study (other regions in Canada, for example) and from other countries (such as the United States).

The emphasis on wildlife valuations as a factor in management decisions has fostered a vast number of studies. This particular study summarizes, consolidates, and synthesizes the past studies, and is unique in that it represents the first attempt to use meta-analysis, a technique for obtaining generalized results, for Canadian wildlife benefit estimates. Meta-analysis has slowly entered the field of economics, and its appearance has contributed to the evolving science of reviewing research (Walsh, Johnson, & McKean, 1989).

Generalizing results from past studies can be useful in three ways. First, knowledge gaps which may exist within the literature can be identified, which can, in turn, enable researchers to identify which species and regions require research to complete the existing databases on Canadian wildlife. Second, the validity of these studies can be tested, so that survey techniques can be improved in order to more

accurately estimate wildlife values. Finally, these results can be applied to policy decisions, such as benefit transfers.

B. Thesis Syllabus

Chapter II contains a review of non-market valuation and demand theory, as well as the theoretical background of meta analysis, including the history of meta analysis techniques, Cooper's Five-Stage Model, and related issues and concerns. The chapter concludes with a summary of the contributions of meta analysis to modern science.

Chapter III documents the methods of data collection and the protocol for the selection of data for this analysis.

Chapter IV contains an appraisal of model development and variable definition. Results of linear and log linear OLS regressions are presented to explain the variability of benefit values. The chapter concludes with a discussion on the implications and comparisons of the study results.

Chapter V documents the conclusions of the study, and examines the need for further study within this area of research.

CHAPTER II
THEORETICAL BACKGROUND

A. Non Market Valuation

1. Utility Theory

Land areas (including forests and wildlife habitat) are composed of goods and services that are often valued by market forces or by alternative techniques. Forest products such as timber, and the products of trapping and grazing, derive their values from the effects of supply and demand within the market. Other forest services, such as ecosystems, hunting, fishing, hiking, and outdoor recreation, are not traded in markets and, therefore, must be valued by such methods as the travel cost model, contingent valuation methods, and hedonic pricing models[1].

The value of market and non-market goods are important to know when addressing development decisions. Economic tools, such as benefit cost analysis, which are used to determine if resources are being used to their highest value and best use, require monetary values for both timber and non-timber resources. The values assigned to each type of resource serve as the base upon which managers can compare the benefits and costs of proposed decisions.

The need to determine compensation for damage to the environment has recently emerged as another reason for determining the value of non-market goods. Individuals and firms are now held liable for damages accrued to environmental assets. For example, residents along the Alaskan coastline were awarded $287 million in compensation for the Exxon Valdez oil spill. This amount was derived through non-market valuation methods, which are now being used in court cases in both Canada and the United States.

The literature on non-market valuation identifies "use values" and "non-use values." Use values are those that an individual holds with respect to his/her participation in a specific activity (Adamowicz, 1992), and are classified as either being

[1] These non-market valuation techniques will be addressed in Section 2.

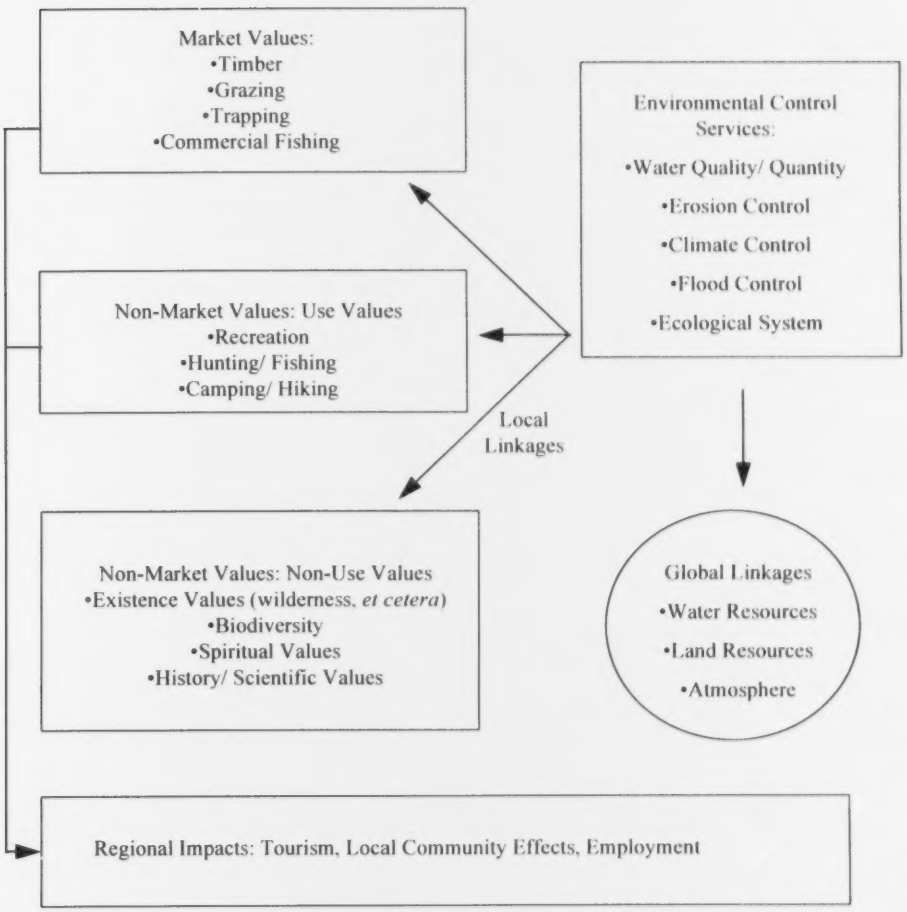
consumptive or non-consumptive. Activities such as hunting and fishing are considered consumptive. Non-consumptive use values represent activities such as bird watching and hiking which do not detract from or affect the resource.

Existence values and bequest values are the two types of non-use values that are held by individuals with respect to those goods or services that are not under active consumption. Existence values are derived from the knowledge that the good exists even though an individual may never use (or visit) it (for example, the Alaskan coastline). Bequest values represent the value that an individual places on the knowledge that the good will be passed on to future generations (such as clean oceans).

Individual demand for wildlife and recreational activities is affected by factors such as tastes and preferences, distance travelled, the price and type of available substitutes, the quality of the site, and species abundance. People demand both timber and non-timber goods; hence, the market values of timber goods are derived from supply and demand transactions, and non-timber goods are valued through other techniques. It is important to understand the nature of the relationships among non-use values, use values, market values, environmental control services, and global elements, in that each factor may influence the other and, consequently, have an impact on the quantity demanded of a particular good or service.

Figure 2.1 (Adamowicz, 1992) illustrates the relationship between market and non-market values, environmental control services, and global elements. Market values such as timber production and grazing can have a positive or negative effect on non-market values. Timber production may necessitate a reduction in the size of the wildlife habitat and ultimately affect the population's demand for non-market activities such as camping and hiking. At the same time, market values and use values are linked to regional impacts, including tourism, employment, and other community issues. Environmental control services and global elements also play roles in market and non-market values. Environmental control services refer to the forest's ability to sustain itself by providing erosion control and maintaining water quality and the ecological system. A change in any one of these control systems will affect both market and non-

Figure 2.1
Timber and Non-Timber Values



Source: Adamowicz, 1992.

market values. For example, a negative change to the wildlife habitat could be detrimental to activities such as fishing and bird-watching; similarly, a change in erosion control could affect timber production and values. Global linkages (the world's water and land resources and atmosphere) also interact with environmental control systems. Indeed, global concerns such as acid rain and pollution can affect the growth of local forests, as the removal of local forests can affect the global environment.

Each of these elements interact, thereby affecting the demand for wildlife and recreational activities on individual and societal levels. By becoming aware of such factors, the "black box" called behavior can be increasingly understood.

2. Valuation Techniques[2]

This section will explore the methods of non-market valuation. Although the literature on this subject is quite extensive, the focus here will be limited to a description of the different valuation methods and the most common flaws of each.

The need to measure non-market goods and services in monetary terms has fostered a number of valuation techniques. There are two main approaches to valuation, the direct (survey) and the indirect (inferential) approach. The direct approach involves asking individuals to value a non-market good or service as if it existed within a market framework. The indirect approach tries to model individuals' behavior. Economists generally prefer the indirect approach to valuation, but studies are increasingly embracing the direct approach.

Figure 2.2 further illustrates the two stems of valuation. The most common direct technique is the contingent valuation method (CVM), which derives from the fact that the value of a non-market good is contingent upon the assumption that a market exists for that particular good (Adamowicz, 1992). The derivation of the benefit value, which is represented as the willingness to pay for the good or accept compensation, can be elicited in two ways, using open-ended or closed-ended questions.

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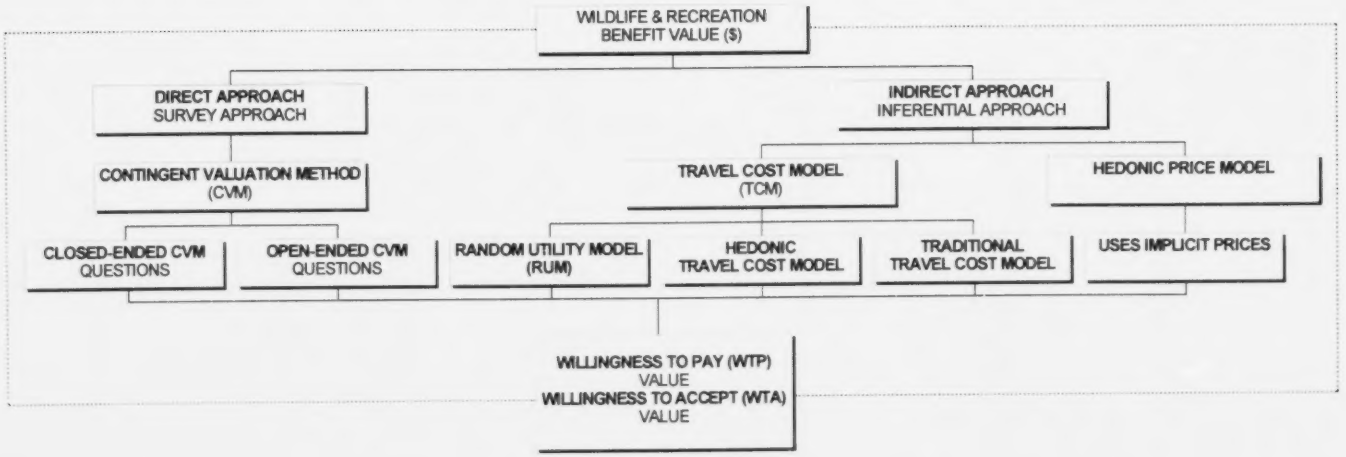
[2] This section is based on W. L. Adamowicz's Project Report 92-02.

Figure 2.2
Valuation Techniques



Open-ended contingent valuation (CV) questions are represented in the following form: "What are you willing to accept/pay for. . . ?" There can either be a range of values from which to choose or a blank line for the participant's response. Closed-ended contingent valuation questions are revealed to the participant as a vote; for example, the respondent would be asked if they would vote "Yes" or "No" to a referendum that would require an annual per capita tax of $100 for improvements to a bird-watching area. The respondent is required to vote "Yes" or "No" to each closed-ended CV question. The responses are then recorded and, through statistical techniques, the expected value of the non-market good is calculated.

Contingent valuation methods are used to determine both use and non-use values. Although CVM is attractive due to its flexibility, it has its flaws, which must be recognized when using this approach. These drawbacks can be classified as three forms of bias. The factors that can influence willingness-to-pay (WTP) or willingness-to-accept (WTA) values are strategic behavior, measurement biases, embedding, and hypothetical issues.

CVM studies may tend to reveal individuals' "wishful thinking" rather than their true valuation of a resource or service. Such inaccurate valuation may reflect strategic behavior, which arises when the survey questions are not presented in a manner consistent with market conditions.

> Perceiving that they will not actually have to pay and that their responses may influence the supply of an extra market good or bad, people may respond in ways that are more indicative of what they would like to see done than how they would behave in an actual market (Bishop & Heberlein, 1979, p. 927).

Measurement biases can also confound CV methods. Mitchell and Carson (1989) identified a number of measurement issues surrounding the CV survey design, ranging from implied value cues (starting point biases, anchors, implied ranges on the

values), to misspecification of the situation (payment vehicle bias), and sample problems (such as sample selection and non-response issues).

Implied value cues such as starting point biases occur when starting bids suggest a range of values for the desired good or service. Hence, the values for a good or service can change as a function of the starting bid. This bias is similar to anchoring, in which the values on bidding cards suggest a range of values within which the respondent forms his/her valuation. Measurement biases can arise if respondents change their valuation of a non-market good/service as a result of a prejudice toward the proposed payment vehicle, which can take the form of taxes, entrance fees, donations, or higher prices. If an individual resents higher taxes, for example, then his/her WTP values may be underrepresented. Sample selection may affect an individual's WTP/WTA if he or she has a major interest in the particular good or service: the higher the stake, the higher the WTP/WTA. Non-response issues, which are another form of the sample problem, occur when a number of the respondents fail to fully complete the survey; as a result, survey responses do not represent the values of the non-respondents.

The third critique of CV techniques is attributed to Jack Knetsch and his co-authors (1992). Knetsch suggests that CVM lends itself to the problems of "warm glow" effects, differences between WTP and WTA values, and embedding.

The "warm glow" effect arises when good feelings are revealed with respect to a particular non-market good or service, instead of its true value (Kahneman & Knetsch, 1991; Knetsch, 1990). Knetsch also suggests that CV methods may produce "the wrong answer to the wrong question." His empirical work shows that WTA is three to ten times larger than WTP, although traditional economic theory states that they should be similar in size. Such disparity is attributable to the income effect (such that individuals' WTP is bound by limited income) and the endowment effect (such that individuals maintain their initial endowments due to a fear of loss). Although they recognize this disparity between the two values, most CVM practitioners continue to use WTP because it is easier to elicit for environmental goods (as compared to WTA) and the

values are reasonable.[3] Hence, when WTA compensation is the most appropriate measure to use, WTP is often used instead, thus producing the wrong answer to the wrong question. A further problem highlighted by Knetsch and Kahneman (1992) is that of embedding. Embedding results when individuals are asked for their WTP for a group of services, of which a portion is already a subset of the previous service. This close linkage between and among services can influence the WTP value if the order in which these services are presented changes, or if the group of services is reduced.

There have been many debates regarding the accuracy of CV methods. Some authors claim that CV techniques are useful, while others claim that they do not provide a true account of monetary value. CV approaches enable us to *estimate* the value of use and non-use goods and services. A number of studies have shown that CV approaches to use values are quite appropriate, because respondents are familiar with the good or services under study. Non-use values, such as biodiversity, ozone, and existence values provide a greater obstacle to CV. Given that CV measures of non-use values may never be tested in terms of market conditions, its appropriateness to non-use valuation will remain in question.

The second stem of valuation is the indirect or inferential approach, which is based on models of economic behavior that are tested through observable data. Travel cost models (TCM) and hedonic pricing methods, the two main techniques of the indirect approach, are only used for use values due to their reliance on the "weak complementarity" assumption, which states that an environmental good/service (such as camping) or quality change is associated with some market purchase (such as travel expenses to the camping site or camping gear). Hence, this assumption provides a link between non-market and market goods. This link or behavioral trail is what economists try to model via indirect methods. Based on the weak complementarity assumption, if there is no demand for the market goods (such as gas and camping gear), there is also no demand for the environmental good or service (camping).

---

[3] WTA compensation values are often "unreasonable," due to their large magnitude.

The travel cost model (TCM), which is generally used to value recreational experiences, has three main forms: the Traditional TCM, the Random Utility Model, and the Hedonic TCM. The Traditional TCM equates travel costs as a proxy for price. Therefore, as the price (travel cost) increases, demand for that recreational activity will decrease. The value for a recreational activity is derived by calculating the area under the demand curve and above the current price. This represents the consumer surplus, and is the individual's willingness to pay for a good or service over and above their current expenditures. The values derived from the Traditional TCM are for the existing site. The Traditional TCM has two major drawbacks: (a) it often ignores the important effects of substitutes, and (b) it cannot be used to measure changes in quality.

Random Utility Models (RUM), also known as Discrete Choice Models, address the problem of substitute sites and quality changes. RUM are based on the notion that utility is a function of site characteristics and socioeconomic factors. When an individual chooses one site over another, that choice yields the highest satisfaction for that person; hence, by using a predefined distribution function (for example, a logistic), one can estimate the welfare value.

Under the Hedonic TCM, it is assumed that people are willing to pay more to visit recreation sites that have superior quality attributes. Information on site attributes and individual choices can provide the implicit prices of these quality attributes (as represented by the difference in travel costs as a result of a change in the quality). Potential problems with the Hedonic TCM include difficulty in the definition of the site and the occurrence of negative prices (see Smith & Kaoru, 1987).

In summary, travel cost models derive values from observations of past behavior rather than intended behavior. They also give us an opportunity to create behavioral models that can be tested. However, TCMs pose problems with respect to model specification (which variables to include or exclude), and to the definition of spatial perceptions, in that individuals' perceptions may differ from that of the researcher(s).

The second indirect valuation approach is the Hedonic Price Model (HPM), which assesses use values and is based on the weak complementarity assumption. The

HPM can estimate the value of changes to environmental quality as well as the value of non-market goods, by linking the market price for a particular good with the environmental conditions and subsequent marketable elements of that good. For example, the purchase price of a home includes marketable elements such as hardwood floors, a brick exterior, *et cetera*, as well as environmental conditions such as noise levels and air quality. The HPM uses statistical models to determine how market elements and non market factors influence the price of a particular good. The implicit price, which is the marginal value of the house with respect to any attribute, is used to evaluate the impact of a change in quality.

Some of the main criticisms of the Hedonic Price Model concern model assumptions. The Hedonic Price Model assumes that prices reflect equilibrium market conditions, meaning that demand equals supply. In cases such as "pressure selling," this assumption does not hold true. A second criticism of the model is its assumption that both buyers of property and sellers (builders) of property have perfect or complete knowledge about market and non-market goods. Since an individual's perceptions are important in the determination of property value, this assumption seems weak.

There is currently a considerable amount of social and political support for valuing non-market goods and services. Economists have two main methods of valuation: the direct (survey) approach and the indirect approach. The direct approach is one method of valuing use values and is the only method of valuing non-use values. In today's environment, some of the most urgent issues can only be evaluated via CVM (for example, rain forest and endangered species valuation). Possible improvements of the CVM method lie in reducing the three forms of bias (strategic behavior, measurement bias, and embedding). The indirect or inferential approach provides numerous ways of measuring use values. This method has provided accurate behavioral models for some situations, and areas of improvement lie in model definition and spatial perceptions.

These two stems of valuation techniques will be key to this analysis. Through meta-analysis, TCM, CVM, and HPM studies will be combined to formulate general

conclusions. The next section outlines the ideology of meta-analysis and shows how it will be used to address variability in wildlife benefit estimates.

B. Meta-Analysis

1. Introduction

The synthesis of results from many types of research is a meta-analytical technique, which is a powerful tool used in the social, behavioral, and physical sciences to make sense of the vast amounts of data that have accumulated over the years. Many argue that additional empirical data are no longer needed; what is required is a mechanism to generalize these past results. This cumulative knowledge can give new insights into conflicting results and provide a foundation upon which new policies can be based. Therefore, meta-analysis has been embraced by many areas of research, including industrial-organizational theory, psychology, medicine, physics, health care, education, and finance. Evidence shows that meta-analysis is also entering the fields of economics, marketing, and human resources. The rapid adoption of meta-analytical techniques is likely to continue as its characteristics are revealed. In reviewing methods of meta-analysis, Bangert-Downs (as quoted in Schmidt) concluded that:

> Meta-analysis is not a fad. It is rooted in the fundamental values of the scientific enterprise: replicability, quantification, and causal and correlational analysis. Valuable information is needlessly scattered in individual studies. The ability of social scientists to deliver generalizable answers to basic questions of policy is too serious a concern to allow us to treat research integration lightly. The potential benefits of the meta-analysis method seem enormous (Schmidt, 1990, p. 41).

How does meta-analysis work? Meta-analysis investigators must first collect all information that is relevant to a specific issue. Then, at least one indicator of the relationship under investigation is constructed from each of the studies collected. These "study level" indicators can be used to compute an array of statistical variables, such as means and standard deviations. Study level data (or accumulated data) can be analyzed

like any other data, such as primary data. A variety of quantitative methods can be used to answer a wide range of questions.

In this thesis, the author will address the question of the explanatory power of survey characteristics when deriving wildlife benefit values. Meta-analysis will be used to help determine how well survey questions reveal or predict the value of wildlife activities. This information will aid the Alberta Fish and Wildlife Division in assessing the potential need for an Alberta hunter survey in the year 1996.

2. History of Meta-Analysis

Although the term "meta-analysis" was coined in the 1970s by Smith and Glass, the idea of synthesizing or combining results from individual studies has had a long history. Many present-day statisticians claim that Legendre invented the principle of Least Squares in 1805 to solve meta-analytic problems. Since 1805, meta-analysis has been used quite extensively by the medical field. In 1904, a famous paper was presented by Karl Pearson on the relationship between immunity from infection and inoculation for enteric fever. This method of analysis was refined, and slowly meta-analysis began to emerge within the social science literature. In 1932, Raymond T. Birge published a paper in the ***Physical Review***, which was devoted to the methodology of combining individual experimental results, calculating the standard error of the combined estimate, and testing the consistency of these results. This published paper made such an impact that Birge's methods are used today by many physicists to combine estimates from several individual studies.

After Birge's paper, meta-analysis began to surface in the statistical literature. Perhaps the most noted study in this area was completed by F. Yates and W. G. Cochran in 1938, a discussion of the problems inherent to combining the results of agricultural experiments. These problems would later reappear and become familiar to modern day meta-analysts.

As in the case of any model or mathematical technique, refinements occur which better explain its power. Two major refinements contributed to the acceptance

and use of meta-analysis in other scientific fields. In their book ***Statistical Methods for Meta-Analysis*** (1985), authors L. V. Hedges and I. Olkin outlined statistical theory as well as the analytical procedures that should be used when performing meta-analysis. In their 1984 book, ***Summing Up: The Science of Reviewing Research,*** R. J. Light and D. B. Pillemer combined quantitative inferential techniques with narrative and descriptive methodologies to prevent the results from the meta-analysis from losing their "substantive meaning." Indeed, the cumulative nature of meta-analysis (which has been shown to be advantageous to researchers), coupled with the modern refinements identified above, has resulted in its rapid adoption and use. In 1986, R. A. Guzzo, S. E. Jackson, and R. A. Katzell tabulated the number of journal articles and dissertations using meta-analysis that were published between 1977 and 1984, with the following results:

Table 2.1
Increased Use of Meta-Analysis

Year	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**
Number of Journal Articles or Dissertations	2	4	6	8	18	32	55	63

The rapid growth in the use of meta-analysis techniques is expected to continue as more specialty fields attempt to generalize the results of the many studies done in their areas.

Table 2.2 on the following page, which was created by Cooper in 1982, outlines the meta-analysis approach and is used by many as a preparatory tool.

Table 2.2
The Integrative Review as a Research Project

Stage Characteristics	Stage of Research				
	Problem Formulation	Data Collection	Data Evaluation	Analysis and Interpretation	Public Presentation
Research Question Asked	What evidence should be included in the review?	What procedures should be used to find relevant evidence?	What retrieved evidence should be included in the review?	What procedures should be used to make inferences about the literature as a whole?	What information should be included in the review report?
Primary Function in Review	Constructing definitions that distinguish relevant from irrelevant studies	Determining which sources of potentially relevant studies to examine	Applying criteria to separate "valid" from "invalid" studies	Synthesizing valid retrieved studies	Applying editorial criteria to separate important from unimportant information
Procedural Differences That Create Variation in Review Conclusions	1. Differences in included operational definitions 2. Differences in operational detail	Differences in the research contained in sources of information	1. Differences in quality criteria 2. Differences in the influence of non-quality criteria	Differences in rules of inference	Differences in guidelines for editorial judgment
Sources of Potential Invalidity in Review Conclusions	1. Narrow concepts might make review conclusions less definitive and robust 2. Superficial operational detail might obscure interacting variables	1. Accessed studies might be qualitatively different from the target population of studies 2. People sampled in accessible studies might be different from target population of people	1. Non-quality factors might cause improper weighting of study information 2. Omissions in study reports might make conclusions unreliable	1. Rules for distinguishing patterns from noise might be inappropriate 2. Review-based evidence might be used to infer causality	1. Omission of review procedures might make conclusions irreproducible 2. Omission of review findings and study procedures might make conclusions obsolete

Source: Cooper, 1982.

3. The Five-Stage Model of Meta-Analysis

In 1982, Harris M. Cooper created a five-step model for meta-analysis, in which he outlines five stages of research and four stage characteristics. These four stage characteristics should be presented at each of the five stages of research to help clarify and organize the data. A clarification of each of the five stages, as illustrated in Table 2.2 (which was reproduced from his article, ***The Integrated Review as a Research Project***), is presented here:

Stage 1: Problem Formulation

It is important for the reviewer to have a clear understanding of the defined variables in which he/she is working. The reviewer can manipulate these boundaries as the review process progresses but, ultimately, must decide "what's in" and "what's out," and the appropriate reasons for same.

Stage 2: Data Collection

In this stage, the reviewer will search the literature on the topic to find responses from the entire population, if possible. The reviewer should be aware that different methods of data collection can affect the "likelihood of whether any individual member of the population is sampled" (Cook, 1992, p.10). For example, reference databases can underrepresent recent literature (if they are not updated), as well as unpublished data. On the other hand, consultation of journal references means that only articles which are compatible with the particular journal will be represented. Therefore, it is important to combine these two data collection techniques in developing the literature review.

Stage 3: Data Retrieval and Evaluation

Reviewers must determine which information is relevant from each study report. Three criteria should be used when determining the usefulness of the data: (a) the faithfulness to the problem area's theoretical underpinnings; (b) the ability of the data to disclose the potential methodological artifacts in the literature; and (c) the reliability of the survey coders, to ensure a clear understanding of the given responses (Cook, 1992, p. 10). Data evaluation focuses upon judging the

quality of the individual data retrieved. This step requires the ability to determine which data is of sufficient quality to be represented in the literature review.

Stage 4: Analysis and Interpretation

This stage requires the reviewer to integrate the individual studies into a unique problem statement. Because meta-analysis is an extension of the results used in the primary data analysis, it is important to conduct the meta-analysis correctly by applying the same assumptions imposed by the primary data; failure to do so will jeopardize the validity of the results.

Stage 5: Public Presentation

A published meta-analysis report should include the following types of information: (a) the method by which the literature was searched, (b) the judging criteria with respect to the applicability of the reports, (c) an outline of the primary research methods, (d) the means by which the tests of the independent hypothesis were identified, (e) the types of statistical procedures and conventions that were used and the reasons for same, and (f) the reasons for the review.

C. Issues and Concerns of Meta-Analysis

Although meta-analysis can be used to make sense of vast amounts of research, it is not without its flaws. Olkin once stated (as quoted in Mann, 1990) that doing a meta-analysis is easy, but doing one well is hard. The reason for the difficulty in completing a successful analysis lies in the researcher's reliance on information in prior studies. The "observational data" poses a few key issues and constraints of which each meta-analyst must be aware. This section addresses the important issues of literature dependency, publishing biases, and synthesis protocol.

Meta-analysis provides a method of identifying gaps in research and knowledge within the literature. The identification of these gaps is a first step in updating the literature so that a comprehensive synthesis can later be performed. When conducting a meta-analysis, the questions are dependent upon the state of the literature. Although primary researchers are limited by their own imaginations, research reviewers can study only those topics that appear in the literature. Therein lies one of the main constraints faced by meta-analysts; a well-formulated question will be of little use, if not impossible to pose, if the problem has not yet been investigated.

The results of the analysis depend not only upon the studies that have been included, but upon those that have been excluded, as well. Therefore, it is important that the literature review is comprised of sources from known databases, references from articles and books, and research reports from fellow scholars and colleagues. There is no need to identify every study on a particular issue, but the methodology used to find them is crucial to avoiding special biases.

One such bias is publishing bias. In most, if not all, scientific fields, published studies report significantly larger effects than do unpublished reports and studies. Hence, a publishing bias exists when authors submit only those reports that exhibit statistically significant results. One possible solution to the publishing bias is the file drawer method proposed by R. Rosenthal in 1979. Rosenthal stated that it is up to the meta-analyst to include reports that are unpublished, such as Master's and Doctoral theses and conference papers, to alleviate such biases.

The documentation of each stage of the analysis represents yet another important issue. A researcher's method of selecting the studies included in the analysis may be subject to criticism, but it is more important that the reasoning behind the methodology be known.

Synthesis protocol is a method of standardizing judgment calls during the coding stage of the analysis. This particular concern did not arise in the course of this study, because all coding was completed by one individual; however, it remains an important issue to be recognized. Cook *et al* (1992) describes three common steps to standardize judgment calls when there is more than one coder: (a) train the coders on the aspects of coding; (b) ask each coder to read the primary report so that he/she can code the information successfully; and (c) keep the study results and study characteristics separate to avoid bias.

The acknowledgment of such common issues, which arise due to the reliance on primary data, will improve the level of research done using meta-analytical techniques.

D. Summary

Perhaps the strongest attribute of meta-analysis is its success in generating a new sense of optimism among all types of social scientists. Such optimism arises from its ability to answer probing social questions. In the past, a large number of studies had accumulated on questions and issues that were important for both policy decisions and theory development. However, the results of these studies conflicted in many cases. Are workers more productive if they are satisfied with their jobs? The studies found no agreement. Do students learn more in smaller classes? Again, the study results were in conflict. So, how to make sense of these conflicts? Unfortunately, both government and private funding agencies became disenchanted and cynical with the conflicting studies, which led to decreased levels of funding in many areas of behavioral and social science. This reduction in private and public funds led the behavioral and social scientists themselves to become cynical about the value of their research (Hunter and Schmidt, 1990). Then meta-analysis created a mechanism that could make sense of the vast number of accumulated study findings. Answers to those important social and political questions now became possible.

> Applications of meta-analysis to accumulated research literature have generally shown that our research findings are not nearly as conflicting as we had thought and that useful general conclusions can be drawn from past research. Cumulative knowledge is possible in the behavioral and social sciences, after all. Socially important questions can be answered. Just as important, it means that scientific progress is possible. It means that cumulative understanding and progress in theory development is possible, after all. It means that the behavioral and social sciences can attain the status of true sciences; they are not doomed forever to the status of pseudo-sciences, or even quasi-sciences. The gloom, cynicism, and even nihilism, that have enveloped many in the behavioral and social sciences today can hope for a much brighter future. (Hunter & Schmidt, 1990, p. 37)

CHAPTER III

THE DATA

A. Data Collection

The data for this meta-analysis were obtained from the wildlife database that was created as part of a research project for the Alberta Fish and Wildlife Division. The database included studies done in Alberta and other Canadian provinces, as well as some northwestern U. S. states from 1968 to 1994. A number of sources were used, including Master's theses, Doctoral dissertations, government reports, journal articles, personal copies of the published and unpublished works of professors and other professionals, national surveys, entries from previous databases, information from tourism agencies, and conference papers. A total of 53 studies were included in the database, providing 181 wildlife benefit estimates.

Most of the studies included in the database were those that pertained to Alberta wildlife and recreation, but the focus was later expanded to include Canadian wildlife and recreation. Therefore, reports executed in Alberta, other Canadian provinces, and border U. S. states were included. Table 3.1 describes the origin of the 53 studies. Alberta studies comprised 47% of the database. Other Canadian studies (including those done in British Columbia, Saskatchewan, Ontario, Newfoundland, and Quebec) composed 23% of the data. Canada-wide and U. S. studies represented 6% and 24% of the data, respectively.

Table 3.1
Origin of Studies

Origin of the Study	Number of Studies
British Columbia	4
Alberta	25
Saskatchewan	2
Ontario	4
Quebec	1
Newfoundland	1
Canada-wide	3
United States	13

Hunting was the subject of 23 studies. The following species were included in the data for Table 3.2: mountain sheep, moose, grizzly bear, mountain goat, elk, black bear, deer, antelope, caribou, cougar, wolf, upland birds, waterfowl, migrating birds, pheasant, and bird game.

Eleven studies concerned fishing, including the following: bass, cold water fishing, warm water fishing, sport fishing, and unspecified fishing.

Eight studies were performed on existence values, one reported on the value of habitat, and 14 studies examined non-consumptive activities, which incorporates all wildlife viewing and recreational activities.

Table 3.2
Summary of Studies Collected

Focus of the Study	*Number of Studies
Hunting (All)	23
Fishing (All)	11
Existence Values	8
Non-Consumptive Activities	14
Value of Habitat	1

*Some include more than one focus of study.

The 53 wildlife benefit reports used three main techniques in valuing wildlife and recreation: (a) the Contingent Valuation Method (CV), including Willingness to Pay (WTP) or Willingness to Accept (WTA); (b) the Travel Cost model (TCM); and (c) the Hedonic Pricing Model. Table 3.3 summarizes the studies collected in terms of their valuation type. Among the 53 studies, 41 contained CV benefit estimates giving 51 WTP and two WTA estimates; 15 contained TCM estimates and two contained Hedonic Pricing estimates. Several studies contained more than one type of estimate.

Table 3.3
Types of Studies Collected

Type of Study	*Number of Studies
CVM	41
WTP	51
WTA	2
TCM	15
Hedonic	2
Other	0

*Some include more than one study type.

The database, which was compiled over a twelve-month period, includes the following variables: ID number, focus of study, author(s), date published, species, geography, sample size, data year, valuation technique, beneficiaries, benefit value, benefit value in terms of 1994 dollars, denominations, survey characteristics, licence fees, variable costs, and capital costs. See Table 3.4 for a comprehensive outline of the database variables. A copy of the database and the corresponding code sheet appear in Appendix A.

Table 3.4
Description of Variables in the Database

Variable Name	Variable Description
Focus Of Study	Descriptive Variable: 9 Distinct Categories
Species	Descriptive Variable: 26 Distinct Categories
Date Published	Years range from 1970 to 1995
Geography	Descriptive Variable: 7 Distinct Categories
Sample Size	Census Data and Sample Size, ranging from 55 to 818,800
Data Year	Years Range from 1968 to 1994
Contingent Valuation Methods (CVM)	Qualitative Variable =0 Not Applicable =1 Open-Ended Questions =2 Closed-ended Questions
Willingness To Pay (WTP)	Qualitative Variable =0 Not Applicable =1 If Applicable
Willingness To Accept (WTA)	Qualitative Variable =0 Not Applicable =1 If Applicable
Travel Cost Model	Qualitative Variable =0 Not Applicable =1 If Applicable
Hedonic Price Model	Qualitative Variable =0 Not Applicable =1 If Applicable
Beneficiaries	Descriptive Variable: 5 Distinct Categories
Denominator Value	Descriptive Variable: 9 Distinct Categories
Benefit Value	Quantitative Value In Dollar Terms
1994 $	Quantitative Value in 1994 Dollars
Survey Characteristics	Qualitative Variable =0 Not Applicable =1 If Applicable
License Fee	Quantitative Value in Dollar Terms
Variable Costs	Quantitative Value in Dollar Terms
Capital Good(s)	Descriptive Variable: 7 Distinct Categories
Capital Good Value	Quantitative Value In Dollar Terms

B. Summary of Data Used

The decision regarding which studies to include in the meta-analysis represents an important step. Improper selection can bias results, such as the publishing bias effect. In an effort to avoid selection bias in this study, the researcher took care to ensure that published and unpublished studies were included in this analysis. Of the 53 studies in the Wildlife Database, 25 were selected for the analysis (including 8 unpublished reports and 17 published studies). These 25 studies reported (a) one Hedonic Pricing Model, (b) 60 CVM, and (c) 31 TCM estimations of wildlife/recreational benefit values. A total of 92 wildlife benefit values were used in the regression analysis. Table 3.5 presents a bibliographic summary of these studies in tabular form at the conclusion of this chapter.

Study selection was based on two criteria. First, all data must have been reported. Studies that did not include surveys or benefit values were omitted from this analysis. Second, those studies for which the benefit value could not be converted into a value per day (such as benefit values derived for a province per year) were also removed from the analysis.

Once the selection process was completed, two additional calculations were made. The common unit used for the analysis was value per hunter/recreational day. Such a unit is defined as any part of a calendar day engaged in hunting or recreational activities. Although most of the CVM studies reported the benefit value per day, most of the TCM benefit estimates had to be converted to such a denominator. Because TCM values usually are reported per trip, these values were converted by dividing the total trip value by the number of days per trip. A second calculation was required to remove inflation bias. For purposes of comparison, the entire range of values (in dollars over the period 1968 to 1990) were converted to 1994 dollars, based on the International Monetary Fund's table directory on annual consumer price indexes (CPI) for both Canada and the United States for the years 1960 to 1994. The CPI indexes were also recalculated to transform the base year from 1990 to 1994.

The following bibliographical table sets forward the authors, publication dates, study types, and study locations for each of the 25 studies in this analysis, which were published from 1970 to 1993, inclusive. The analysis uses predominately Canadian data; for example, there are 13 studies on Alberta, three studies on Ontario, and two reports on British Columbia. Full bibliographical citations appear at the conclusion of this thesis.

Table 3.5
Bibliographical Table of Studies

Authors	Date	Study Type	Geographic Location
Adamowicz	1983	hunting big game	Alberta
Adamowicz, *et al*	1986	duck production	Alberta
Asafu-Adjaye	1986	recreational hunting	Alberta
Bodden, *et al*	1986	pheasant hunting	Alberta
Boyle	1988	wildlife resources	Maine
Donnelly, *et al*	1986	deer hunting	Idaho
English, *et al*	1984	fishing	Alberta
Hvenegaard, *et al*	1989	bird watching	Ontario
Legg	1993	recreational fishing	Ontario
Lommis, *et al*	1985	unique species hunting	Idaho
Menz	1983	recreation	Ontario/ Quebec
Miller	1971	hunting and fishing	Alberta
Pattison	1970	moose hunting	Alberta
Phillips, *et al*	1977	recreational fishing	Alberta
Phillips, *et al*	1977	recreational fishing	Alberta
Prather	1974	big game hunting	Alberta
Reid	1985	resident hunting	British Columbia
Reid	1985	non-resident hunting	British Columbia
Sorg, *et al*	1986	elk hunting	Idaho
Sorg, *et al*	1987	water fowl hunting	Idaho
Sorg, *et al*	1986	cold and warm water fishing	Idaho
Thompson, *et al*	1987	river recreation	Alberta
Thompson, *et al*	1987	recreational use	Alberta
Wilson	1983	wildlife resources	Alberta
Young, *et al*	1987	upland game hunting	Idaho

CHAPTER IV

MODEL DEVELOPMENT, ESTIMATION, AND RESULTS

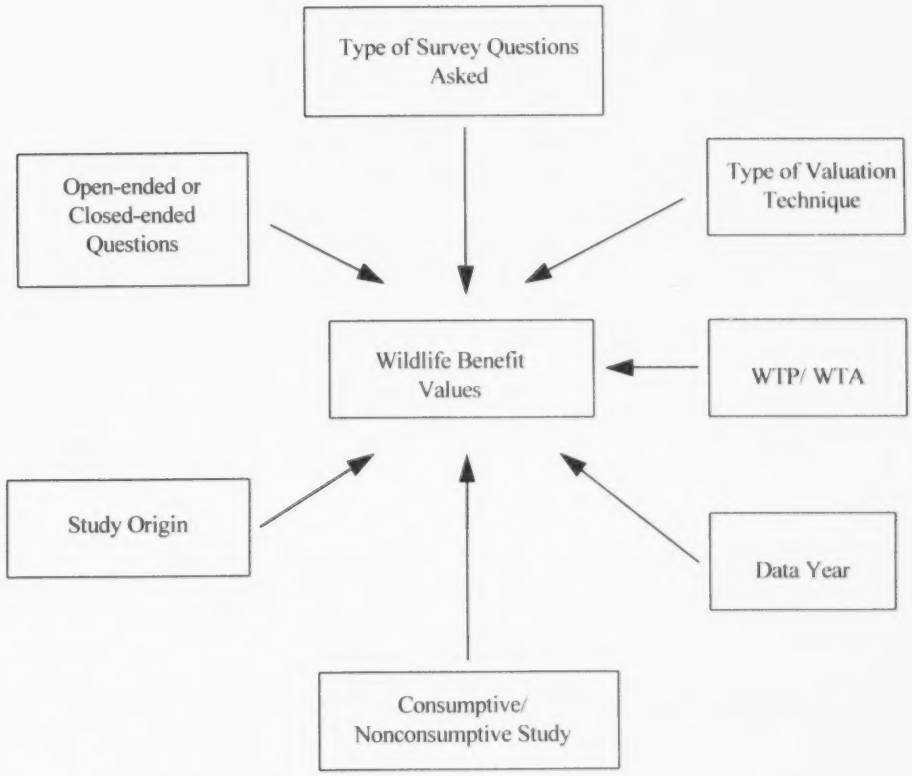
A. Model Development

1. Introduction

Since the 1980s, there has been a movement to fill the gaps in the literature with respect to benefit estimation. The trend toward benefit cost analysis and environmental litigation has fueled this effort. The benefit estimates themselves may be used for benefit transfers, but generalized results can also address large-scale policy questions. Meta-analysis gives researchers the basis upon which to test the systematic relationship between benefit values and survey characteristics.

The basic empirical hypothesis of this thesis is that the variation of benefit values can be explained by (a) the types of survey questions asked, (b) the types of estimation models used, (c) the year of the study and (d) the country in which it was conducted, (e) whether the questions were of the "willingness to pay" or "willingness to accept" variety, (f) the format of the questions (*ie* open- or closed-ended), and (g) the study type (its examination of consumptive versus non-consumptive activities). Figure 4.1 illustrates the known factors that influence the wildlife and wildlife-related benefit values.

Figure 4.1
Factors that Affect Wildlife and Wildlife-Related Benefit Values



2. Variable Description

This section defines the explanatory variables used in the analysis. Most of the variables are qualitative in nature, and indicate whether a particular treatment is absent or present. Table 4.1 documents the format of the OLS regressions. The dependent variable is the wildlife/recreational benefit estimate, which has been converted to 1994 dollars for purposes of comparison. The variables used in this analysis were limited by the nature of the studies and time.

Table 4.1
The Explanatory Variables Used in the Analysis

Variable Name	Description of Variable
Dependent Variable	
Benefit Value (BEN)	Wildlife or recreational benefit value, adjusted to 1994 dollars and standardized to values per recreational/ hunting day
Independent Variables	
Substitute Site (SUB)	Qualitative variable =1 if included in survey =0 if omitted
Method (MET)	Qualitative variable =1 if CVM =0 if TCM or Hedonic
Country Variable (COUV)	Qualitative variable =1 if study conducted in Canada =0 if study conducted in the USA
Data Year (DYEAR)	Qualitative variable =1 if data were collected for the study prior to 1980 =0 if data collected from 1980 to 1985
Willingness to Pay (WTP)	Qualitative variable =1 if WTP was elicited =0 if WTA or other
Open-Ended Questions (OED)	Qualitative variable =1 if open-ended questions used in the CVM =0 if otherwise
Recreational/ Wildlife Study	
Hunting (HUNT)	Qualitative variable =1 if hunting study =0 if otherwise
Fishing (FISH)	Qualitative variable =1 if fishing study =0 if otherwise
Non-Consumptive Hunting and Wildlife Activities (NONCOM)*	Qualitative variable =1 if non-consumptive study =0 if otherwise

* Used as base case

B. Estimation and Model Results

1. Model Estimation and Results

The regression was estimated using ordinary least squares (OLS). The data exhibited both multicollinearity and heteroskedasticity due to the nature of the studies. Multicollinearity exists because more than one benefit value is reported in most studies. This represents a problem which will not be alleviated by increasing the amount of data. Heteroskedasticity occurs because benefit values are derived from empirical models based on quite different data sets and estimation methods.[4] The presence of heteroskedasticity could also indicate that earlier TCM and CVM studies valued a small variety of non-market goods but, as these methods improved, the range of non-market goods that were valued by these means was substantially increased.

The estimation consisted of including those variables that *a priori* would explain the variation in wildlife values. The explanatory variables in the analysis include (a) the substitute site, (b) the method, (c) the study origin, (d) consumptive hunting and fishing, (e) open-ended questions, (f) willingness to pay, and (g) data year. The results of the OLS regressions are shown in tables 4.2 and 4.3. These results reflect the use of non-consumptive wildlife activities as the base case. This case will allow for comparisons between consumptive and non-consumptive activities.

Table 4.2 documents the results of the linear OLS regression. The adjusted R-squared is 30%, which indicates that 30% of the total variation in the reported values is explained by the variables included in the functions. The significant variables are substitute site, hunting, and willingness to pay. The benefit value is in 1994 dollars; therefore, the significant variables can be interpreted in the following manner: If individuals were asked about possible substitute sites, the benefit value was $22 less than if the question had not been asked. A possible reason for such a result may be that when individuals are prompted to think about alternative sites, they might report a decreased wildlife value as more alternatives are identified. Hunting activities are

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[4] Heteroskedasticity was corrected for by the "Hetcov" command in Shazam. This command uses White's (1980) Heteroskedastic-Consistent Covariance Matrix estimation to correct the estimates for an unknown form of heteroskedasticity (Shazam User Reference, page 71, 1993).

positive, which indicates that hunters increase the wildlife values by $31 over and above non-consumptive wildlife activities. Willingness to pay is negative, which indicates that people will decrease the wildlife/recreational value by $79 if they are asked about their "willingness to pay" versus their "willingness to accept." Economic theory and practice have shown that such a result is accurate for the following reasons: (a) individuals' willingness to pay is bounded by income constraints, (b) the "endowment effect," and (c) the fewer the substitutes, the larger the WTA value (Kahneman and Knetsch, 1992).

Table 4.2
Results of Linear OLS Regression

Variable	Estimated Coefficient	*p* value	α =0.10 Adjusted R^2 =0.2984 Mean of Dependent Variable = 75.0
SUB	* -22.077	.027	
MET	-103.72	.153	
COUV	-11.245	.565	
HUNT	* 31.042	.041	
FISH	27.490	.174	
OED	86.873	.279	
WTP	* -79.962	.019	
DYEAR	4.4961	.803	
CONSTANT	* 139.80	.001	

* Estimated coefficients are significant at the .10 level

Table 4.3 shows the results of changing the functional form of the regression to log linear (by taking the natural log of the dependent variable only). Note that the goodness of fit (adjusted R^2 value) has increased to 40%.[5] Furthermore, one additional variable (fishing) becomes significant at the 0.10 level. The effects of the significant variables on the wildlife and recreational benefit values are larger than those in the linear model. To derive the real effects of the explanatory variables on the

[5] Achieving a better fit was the motivation for changing the functional form to log linear. One must be careful in drawing conclusions based on the adjusted R^2 values alone, for the dependent variables are not the same. Therefore, direct comparison of the variation of wildlife benefit estimates is explained by the independent variables, and not by the adjusted R^2.

wildlife benefit estimates, the estimated coefficients were multiplied by $75 (the mean value of the dependent variable). Therefore, the real effects of these variables on the wildlife benefit estimates are termed "adjusted" estimated coefficients in Table 4.3. The estimated coefficient of substitute sites is again negative, indicating that individuals decrease the wildlife benefit estimates by $51 if asked such questions, versus if they are not asked at all. The coefficients for hunting and fishing are positive, resulting in wildlife values $105 and $96 higher, respectively, than the base case of non-consumptive wildlife activities. Finally, the coefficient for WTP is again negative, indicating that individuals will decrease the wildlife benefit value by $45 if asked WTP questions versus WTA compensation questions.

Table 4.3
Results of Log Linear OLS Regression

Variable	Estimated Coefficient	*p* value	Adjusted Estimated Coefficients	α =0.10 Adjusted R^2 =0.4010 Mean of log dependent variable=4.00
SUB	* -.68783	.040	-51.58	
MET	-.64780	.148	-48.58	
COUV	.081098	.967	6.08	
HUNT	* 1.4113	.002	105.84	
FISH	* 1.2833	.007	96.24	
OED	.15602	.745	11.70	
WTP	* -.60061	.019	-45.04	
DYEAR	-.24327	.253	-18.24	
CONSTANT	* 3.7531	.000	281.48	

* Estimated coefficients are significant at the .10 level

The linear and log linear OLS regressions resulted in noteworthy insignificant variables (country, data year, method, and open-ended questions).[6] The country variable was included in the analysis to test if U. S. (Canadian) citizens value wildlife resources differently. The insignificance of the variable indicates that results of the

[6] The specified models are not strongly robust in that removal of insignificant variables caused some of the other variables to become (in)significant. This is attributed to collinearity between the variables.

studies completed in the United States are not significantly different than those reported in Canadian studies. One can speculate that participants in both countries value wildlife in a similar manner. This result supports the idea of information transfers between the United States and Canada.

A second interesting insignificant result is the data year variable. This variable was included in the analysis to represent improvements in the CVM and TCM techniques. The variable was to capture two possible scenarios: (a) that, over the years, the methods of non-market valuation have greatly improved, resulting in more "accurate" benefit values; or (b) as individuals become more aware of the destruction and scarcity of the wildlife habitat on both a local and global level, their valuation of activities such as hunting, fishing, camping, and hiking also increase. The insignificance of the data year reveals that, between 1970 and 1995, benefit values have more or less remained the same (after removing the effects of inflation by adjusting the benefit values to 1994 dollars).

The third insignificant variable was valuation method. Bishop *et al* (1988) revealed that, traditionally, TCM Benefit Values were larger than CVM Benefit Values. This resulted from the fact that TCM techniques value both primary and secondary activities, while CVM techniques only value the primary activities. The results of the regression show that benefit values derived from the TCM and CVM are not significantly different. This result is encouraging, in that refinements of the two valuation techniques have brought their results closer together.

The final insignificant results of the linear and log linear regressions concerned the open-ended questions. Economic studies such as that of Holmes and Kramer (1995) show that closed-ended questions elicit larger benefit values than open-ended questions. The higher closed-ended values arise because individuals feel morally motivated to increase the bid value, for saying "no" to the proposed bid will make them appear as if they do not value the non-market good or service in question. The results of this study, however, indicate that open-ended and closed-ended questions are not significantly different from each other. This could have arisen from

the fact that most of the CVM studies included within this analysis (14 of 25) were open-ended in nature. Perhaps a better way of capturing this variable would be to use it in a meta-analysis of only CVM studies.[7]

2. Implication of Results

The literature on benefit values for wildlife and environmental resources is growing rapidly, and summarizing it is becoming more difficult. The results of this research must be considered tentative and subject to change as more advances are made in this area, particularly with respect to the definition of other variables that may capture the variability of wildlife benefit values. Walsh *et al* (1989) identified some new explanatory variables that may be significant, such as payment vehicles, the monetary and time cost of travel, and site quality and uncertainty.

Even though these results must be considered tentative, they show that the consolidation of empirical studies can be done successfully, and with important implications. By its nature, meta-analysis exposes both knowledge gaps and known literature. Indeed, knowing what has been explored is as valuable as clearing the direction for further research. The identification of knowledge gaps provides a means to allocate money and effort to those areas in need of research (to create a solid literature base) while avoiding instances of repetition.

These results also imply that as the literature base grows and becomes complete, it will provide a foundation upon which general conclusions can be drawn. Policy makers need to know what works "in general," and this is what can be tested by meta-analysis (Cook *et al*, 1992).

Finally, this research shows that questions both posed and not posed affect wildlife benefit values. In most cases, specific questions about such things as substitute sites prompt individuals to consider a more accurate value of wildlife and recreation. Gaining an awareness of those questions that require the individual to

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[7] Referring to the study completed by Walsh *et al* (1989), the variable "open-ended" question was reserved for the meta-analysis performed on CVM studies.

provide a more "educated" value is beneficial on two accounts: first, more accurate wildlife and recreational values can influence the determination of proper compensation for human-made environmental disasters; and, second, policies such as benefit transfers that rely heavily on benefit valuations will reflect a more accurate societal demand for wildlife.

3. Comparison of Results

This research is unique in that it is the first study conducted on predominately Canadian data. Two U. S. meta-analytic studies conducted in similar areas were performed by Walsh *et al* (1989) and Smith *et al* (1990). References to both studies were made often in the course of this research.

The first meta-analytic study conducted on recreation benefits was performed by Richard Walsh, Donn Johnson, and John McKean in 1989. The study used the tools of meta-analysis to address variability in recreation benefit estimates. The analysis used 287 adjusted CVM and TCM estimates of net economic value from a total of 120 outdoor recreation studies, which were completed from 1968 to 1988. Walsh *et al* developed an OLS regression model by using the consumer surplus per day in 1987 dollars as the dependent variable. The independent variables in his analysis included site quality, forest service administered, mixed public and private sites, specialized activity, inflationary adjustment, sample coverage, method, substitute price term, travel time, individual observation, hedonic price model, open-ended questions, dichotomous choice questions, socioeconomic characteristics, and recreation activity.

The second meta-analytic study was conducted by Kerry Smith and Yoshiaki Kaoru in 1990. This study used meta-analysis to explain variation in consumer surplus estimates. The analysis was performed on 77 travel cost recreation demand studies, and provided a total of 734 consumer surplus values. The dependent variable of the analysis was the consumer surplus estimate per unit of use (per day or per trip), corrected (inflated) according to the consumer price index. The independent variables

used included unit use type, recreation activities, recreation site, substitute site, opportunity cost of travel time, regional variable, model specification (linear, semi-log or log linear), data year, and the estimators used.[8]

Combining the results of the two U. S. studies on recreation activities with the results of this research can provide a means of comparison. Table 4.4 documents the variables used, as well as those that were significant in each of the three studies. The study completed by Walsh *et al* included three analyses: TCM, CVM, and a combined total. The results from all three analyses are presented in Table 4.4 and Table 4.5. The study conducted by Smith *et al* resulted in eight models, of which model eight was chosen for this comparison, because it included most of the study variables and was the best model form. The results from this study are reviewed by the type of model performed (linear and log linear). Symbols in the legend include an asterisk (to represent the significant variables), a dash (to identify those variables that are not used in the analysis), and an empty cell in the table (to represent non-significant variables).

The following direct comparisons can be drawn with respect to Table 4.4. Variables such as substitute sites (where substitute sites in the Walsh *et al* and Smith *et al* studies were included in the TCM specification and the "sub" variable in this study indicates that substitute sites were included in the CVM surveys) and type of activity were significant in all three studies. Research for this thesis and in the Walsh *et al* study both use method and open-ended variables, but these are significant only in the Walsh *et al* study. The variable travel time was significant in both the Smith *et al* and Walsh *et al* studies. Finally, each of the three studies included variables that were specific to their problem statement, and which, in most cases, were significant.

Table 4.5 summarizes the adjusted R-squared value, number of studies, sample size, and means of the dependent variables of the three studies. Again, the information for Table 4.5 includes the following: the three analyses of the Walsh *et al*

[8] Refer to the actual studies for specific details of the variables used.

Table 4.4
Study Comparisons

Variables Used	Walsh, *et al* 1989			Smith, *et al* 1990	Rush 1995	
	TOTAL	TCM	CVM	MODEL 8	LINEAR	LOG LINEAR
Substitute Sites	—	*	—	*	*	*
Method	*	—	—	—		
Country Variable	—	—	—	—		
Regional Variable	—	*	—	—	—	—
Type of Activity	*	*	*	*	*	*
Open-Ended Questions	—	—	*	—		
Willingness to Pay	—	—	—	—	*	*
Data Year	—	—	—			
Inflation Adjustment		*	*	—	—	—
Site Quality	*	*	*	—	—	—
Forest Service Administration				—	—	—
Mixed Public/ Private Sites	*	*	*	—	—	—
Travel Time	—	*	—	*	—	—
Individual Observation	—	*	—	—	—	—
Use Type	—	—	—	*	—	—
Model Specification	—	—	—	*	—	—
Estimator	—	—	—		—	—
Type of Site	—	—	—	*	—	—

Legend
(*) represents significant variables
(—) represents variables that are not in the analysis
( ) represents non-significant variables

Table 4.5
Comparison of Summary Statistics

Study	Adjusted R^2 (%)	Number of Studies	Sample Size (n)	Mean of Dependent Variable ($)
Walsh *et al* (1989)				
Total	36	120	287	
TCM	39		156	
CVM	44		129	
Total Consumer Surplus per Day				34
Smith *et al* (1990)				
Total TCM (model 8)	43	77	399	
Consumer Surplus per Use				25
Rush (1995)				
Linear	30	25	92	
Log Linear	40	25	92	
Consumer Surplus per Day (Linear)				75

study, the results of model eight from the Smith *et al* study, and the results of the two model forms (linear and log linear) of this research.

CHAPTER V

SUMMARY AND CONCLUSIONS

A. Summary

The research in this thesis reveals that meta-analysis can be effectively used to generate information about the variability of wildlife benefit values. These results prove that there exists a systematic relationship between benefit estimates and the types of questions posed. The initial stage of the research included consolidating the wildlife literature into a database and determining the factors that may influence benefit estimates. The explanatory variables used in the analysis included substitute sites, the method of estimation, the origin and year of study, as well as questions concerning consumptive activities, open-ended questions, and willingness to pay. The base case to which the results were compared concerned non-consumptive wildlife activities. Two functional forms, linear and log linear, were estimated using OLS.

The results from the linear regression reveal that three variables, (a) substitute sites, (b) consumptive hunting, and (c) willingness to pay, explain 30% of the variability of wildlife estimates. The log linear regression results show that 40% of the variability is captured by the variables denoting substitute site, consumptive hunting and fishing, and willingness to pay.

These results must be considered tentative and subject to change as new studies emerge on meta-analytical summaries of wildlife and environmental resources. However, the data from the linear and log linear regression indicate that econometric methods can synthesize results from numerous empirical studies.

B. Further Research Needs

Meta-analysis and its use in economics is still relatively new, so many research avenues exist. Walsh *et al* (1989) noted that, as more environmental work is completed using meta-analysis, it becomes increasingly important to view these studies as stepping stones to future research. The use of prior reviews to reduce the number of experimental variables should improve the statistical analysis as well as the allocation of resources to new studies. Thus, each successive literature review should build upon those that have come before it (Walsh *et al*, 1989, p. 181).

As economic literature bases grow saturated with empirical studies, the focus will shift toward the derivation of general results. The specification of other explanatory variables is one area for further research that will be needed to facilitate a smooth transition between empirical studies and generalized results. Smith and Kaoru (1990) explained that the omission of important variables from the analysis can cause those variables that are included to capture more or less of the variation than would have been the case had a complete specification of the model occurred. Thus, there is a concurrent need to remove insignificant variables from the analysis and to specify other explanatory variables.

Three other distinct areas that could be explored focus upon (a) exchange rates (for those studies that incorporate data from different countries), (b) weighting systems for different levels of study quality, and (c) meta-analyses for per-trip data. Exchange rates pose a unique problem when addressing non-market valuation. Some questions that would require further research are (a) which exchange rate is used if such rates change over the course of the study, and (b) does one employ the rule of "purchasing power parity" (which means that the good that the domestic economy exports is indistinguishable from the goods available elsewhere [Scarth, p. 124, 1988]). Another avenue of research could analyze study quality (credibility) via weighting systems. These weighting systems could be based upon the sample size of the data; hence, the larger the sample size, the larger the weight for study quality. The third area of research includes conducting a meta-analysis on data of a per-trip

denomination. Many TCM studies are now reporting values on a per-trip basis, rather than per day; therefore, it would be interesting to explore the results of an analysis using a dependent variable of a per-trip classification.

Meta-analytic reviews serve to update and order vast amounts of subject literature. A final area of research would be to fill the knowledge gaps that currently prevent a successful meta-analysis. When performed on completed literature bases, meta-analysis can control chance and other elements that appear in individual studies. Only then will it be prudent to use meta-analysis for policy decisions.

> Meta-analysis has clearly shown that no single primary study can ever resolve an issue or answer a question. Research findings are inherently probabilistic (Taveggia, 1974), and, therefore, the results of any single study could have occurred by chance. Only meta-analytic integration of findings across studies can control chance and other artifacts and provide a foundation for conclusions. And yet meta-analysis is not possible unless the needed primary studies are conducted. (Source: Hunter and Schmidt, 1990)

C. Conclusions

This is the first meta-analytic study to be conducted on predominately Canadian data. The research shows that combining literature on wildlife benefit estimation can provide generalized results. More specifically, this study proved that there is a systematic relationship between the wildlife benefit estimates and the features of the empirical study. The results of this thesis are tentative, for more research is needed in this area to strengthen this type of analysis. They can, however, provide a stepping stone for future meta-analysis in both the literature review and variable definition.

This model focused upon (a) the types of questions asked, (b) the valuation method, (c) the origin, (d) the data year, (e) the type of CVM questions, and (f) the focus of the study. The model, however, is not limited to these variables. Factors such as TCM specification (such as (ex)inclusion of the opportunity cost of travel time), regional variables, and site quality could be used to broaden the score of this model.

Policy analysis on benefit transfers, which include (a) transferring per unit benefit estimates from an origin site to a new application, and (b) creating an aggregate estimate for the relevant population from per unit benefit estimates (Smith *et al*, p. 420, 1990), has been rapidly growing. The idea of applying past studies to future policy decisions has been fueled by budget constraints and increased demand for non-market valuation studies. One result from this thesis indicates that study results from the United States (Idaho and Maine) could be adopted in Canada. The model did not examine the impact of benefit values from different regions within Canada, but one could speculate that the benefit values are not significantly different between regions. Ultimately, this could indicate that, in times of restricted budgets, sharing of information between regions and borders would be successful.

Perhaps a final area in which meta-analysis can be beneficial is in non-market valuation. The results of this study reveal that there are important variables that directly affect wildlife benefit values. Having a systematic approach to identify these variables can improve the quality of non-market valuation techniques (CVM and

TCM). Ultimately, meta-analysis could serve as a valuation method due to its ability to clarify significant variables that affect wildlife benefit estimates.

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APPENDIX A:

SAMPLE OF CODE SHEET AND SAMPLE OF WILDLIFE DATABASE

WILDLIFE VALUE DATABASE

CODE SHEET

FOCUS OF STUDY OPTIONS

1. Recreational Hunting
2. Recreational Fishing
3. Bird Watching
4. Existence Values
5. Non-Consumptive Sport Fishing and Wildlife Activities
6. Total Economic Value
7. Environmental Quality Change
8. Valuation of Fish and Wildlife Habitat
9. Aesthetic Value of Wildlife

SPECIES

1. Mountain Sheep
2. Moose
3. Grizzly Bear
4. Mountain Goat
5. Elk
6. Black Bear
7. Sport Fishing
8. Big Game Hunting
9. Upland Birds
10. Waterfowl
11. Caribou
12. All Migrating Birds
13. Deer
14. Upland Game
15. Antelope
16. Unspecified Hunting
17. Unspecified Fishing
18. All Wildlife
19. Pheasant
20. Cold Water Fish
21. Warm Water Fish
22. Bird Game (9+10)
23. Bass
24. Recreational Activities
25. Cougar
26. Wolf

GEOGRAPHICAL INFORMATION

1. Country
2. Province/State
3. Region
4. Country
5. Zone
6. Wildlife Management Unit
7. Other

WILDLIFE VALUE DATABASE

CODE SHEET, CONTINUED:

CONTINGENT VALUATION

0. N/A
1. Open Ended
2. Closed Ended

WILLINGNESS TO PAY

0. N/A
1. Applicable

WILLINGNESS TO ACCEPT

0. N/A
1. Applicable

TRAVEL COST MODEL

0. N/A
1. Traditional Travel Cost Model
2. Random Utility Model

HEDONIC MODEL

0. N/A
1. Applicable

BENEFICIARIES

1. Regional
2. Provincial Residence
3. Canadians
4. Non-Canadians
5. Non-Residents

WILDLIFE VALUE DATABASE

CODE SHEET, CONTINUED:

DENOMINATOR VALUE

1. Per Recreational Experience
2. Per Person/ Hour
3. Per Person/ Hunter Day
4. Per Person/ Trip
5. Per Group/ Year
6. Lump Sum Quality Change
7. Per Person/ Season/ Year
8. Per Acre
9. Per Province/ Year

SURVEY CHARACTERISTICS (ALL FIELDS)

0. Not Included
1. Included

N/A Survey Unavailable

TYPE OF SURVEY USED

1. In Person
2. Telephone
3. Mailing Questionnaire

CAPITAL COSTS/ GOODS

0. Not Fully Specified/ Not Included
1. Vehicle
2. Rifles and Ammunition
3. Camping Gear
4. Binoculars
5. General Equipment
6. Rental Costs
7. Camera and Film

VARIABLE COST (VALUES)

N/A Information Missing

SAMPLE OF WILDLIFE DATABASE

	ID NUMBER	FOCUS OF STUDY
1	#1	1
2	#1	1
3	#1	1
4	#1	1
5	#1	1
6	#1	1
7	#1	1
8	#1	1
9	#1	1
10	#1	1
11	#2	2
12	#2	1
13	#3	1
14	#3	1
15	#4	1
16	#4	1
17	#4	1
18	#5	4
19	#5	4
20	#6	3
21	#7	1
22	#8	1
23	#8	1
24	#9	1
25	#10	1
26	#10	1
27	#11	1
28	#11	1
29	#12	1
30	#12	1
31	#12	1
32	#12	1
33	#13	5
34	#13	5
35	#14	4
36	#14	4
37	#14	6
38	#14	6
39	#15	8
40	#15	8
41	#16	7
42	#16	7
43	#17	1
44	#17	1
45	#17	1
46	#17	1
47	#17	1
48	#17	1
49	#17	1
50	#17	1

SAMPLE OF WILDLIFE DATABASE

	AUTHOR(S)
1	Adamowicz. W.L.
2	Adamowicz. W.L.
3	Adamowicz. W.L.
4	Adamowicz. W.L.
5	Adamowicz. W.L.
6	Adamowicz. W.L.
7	Adamowicz. W.L.
8	Adamowicz. W.L.
9	Adamowicz. W.L.
10	Adamowicz. W.L.
11	Miller. R.J.
12	Miller. R.J.
13	Pattison. W.S.
14	Pattison. W.S.
15	Wilson. W.R.
16	Wilson. W.R.
17	Wilson. W.R.
18	Tanguay. M.R.
19	Tanguay. M.R.
20	Hvenegaard. G.T., Butler. J.R., Krystofiak. D.K.
21	Condon. B.S.
22	Sorg. C.F., Nelson. L.J.
23	Sorg. C.F., Nelson. L.J.
24	Donnelly. D.M., Nelson. L.J.
25	Sorg. C.F., Nelson. L.J.
26	Sorg. C.F., Nelson. L.J.
27	Young.J.S., Donnelly. D.M., Sorg. C.F., Loomis. J.B., Nelson. L.J.
28	Young.J.S., Donnelly. D.M., Sorg. C.F., Loomis. J.B., Nelson. L.J.
29	Loomis. J.B., Donnell. D.M., Sorg. C.F., Oldenburg. L.
30	Loomis. J.B., Donnell. D.M., Sorg. C.F., Oldenburg. L.
31	Loomis. J.B., Donnell. D.M., Sorg. C.F., Oldenburg. L.
32	Loomis. J.B., Donnell. D.M., Sorg. C.F., Oldenburg. L.
33	Phillips. W., DePape. D., Ewanyk. L.
34	Phillips. W., DePape. D., Ewanyk. L.
35	Asafu-Adjaye. J.
36	Asafu-Adjaye. J.
37	Asafu-Adjaye. J.
38	Asafu-Adjaye. J.
39	Macnab. B., Brusnyk. L.
40	Macnab. B., Brusnyk. L.
41	Morton. K.M.
42	Morton. K.M.
43	Phillips. W., DePape. D., Ewanyk. L.
44	Phillips. W., DePape. D., Ewanyk. L.
45	Phillips. W., DePape. D., Ewanyk. L.
46	Phillips. W., DePape. D., Ewanyk. L.
47	Phillips. W., DePape. D., Ewanyk. L.
48	Phillips. W., DePape. D., Ewanyk. L.
49	Phillips. W., DePape. D., Ewanyk. L.
50	Phillips. W., DePape. D., Ewanyk. L.

SAMPLE OF WILDLIFE DATABASE

	DATE PUBLISHED	SPECIES	GEOGRAPHY	SAMPLE SIZE
1	1983	2	2	104
2	1983	3	2	174
3	1983	4	2	N/A
4	1983	5	2	112
5	1983	6	2	55
6	1983	2	2	104
7	1983	3	2	174
8	1983	4	2	N/A
9	1983	5	2	112
10	1983	6	2	55
11	1971	7	2	N/A
12	1971	8	2	N/A
13	1970	2	5	415
14	1970	2	5	415
15	1983	9	2	167
16	1983	10	2	323
17	1983	8	2	299
18	1994	11	2	908
19	1994	11	2	1074
20	1989	12	5	603
21	1993	2	2	1255
22	1986	5	2	1629
23	1986	5	2	1629
24	1986	13	2	1445
25	1987	10	2	1479
26	1987	10	2	1479
27	1987	14	2	1479
28	1987	14	2	1479
29	1985	4	2	census
30	1985	1	2	census
31	1985	2	2	census
32	1985	15	2	census
33	1977	24	3	410
34	1977	24	3	689
35	1989	3	2	2590
36	1989	8	2	2590
37	1989	3	2	2590
38	1989	8	2	2590
39	1993	16	2	2170
40	1993	17	2	611
41	1993	13	2	1577
42	1993	2	2	1526
43	1977	8	6	680
44	1977	9	6	680
45	1977	10	6	680
46	1977	16	6	680
47	1977	8	3	398
48	1977	9	3	398
49	1977	10	3	398
50	1977	16	3	398

SAMPLE OF WILDLIFE DATABASE

	DATA YEAR	C.V.	W.T.P.	W.T.A.	TRAVEL COST
1	1981	1	1	0	0
2	1981	1	1	0	0
3	1981	1	1	0	0
4	1981	1	1	0	0
5	1981	1	1	0	0
6	1981	1	0	1	0
7	1981	1	0	1	0
8	1981	1	0	1	0
9	1981	1	0	1	0
10	1981	1	0	1	0
11	1968	1	1	0	0
12	1968	1	1	0	0
13	1968	1	1	0	0
14	1968	1	1	0	0
15	1976	1	1	0	0
16	1976	1	1	0	0
17	1976	1	1	0	0
18	1992	1	1	0	0
19	1992	1	1	0	0
20	1987	1	1	0	0
21	1992	1	1	0	0
22	1983	1	1	0	0
23	1983	0	1	0	1
24	1982	0	1	0	1
25	1982	0	1	0	1
26	1982	1	0	0	0
27	1982	0	1	0	1
28	1982	1	1	0	0
29	1982	0	1	0	1
30	1982	0	1	0	1
31	1982	0	1	0	1
32	1982	0	1	0	1
33	1976	1	1	0	0
34	1976	1	1	0	0
35	1987	2	1	0	0
36	1987	2	1	0	0
37	1987	2	1	0	0
38	1987	2	1	0	0
39	1991	2	1	0	0
40	1991	2	1	0	0
41	1992	0	1	0	2
42	1992	0	1	0	2
43	1976	1	1	0	0
44	1976	1	1	0	0
45	1976	1	1	0	0
46	1976	1	1	0	0
47	1976	1	1	0	0
48	1976	1	1	0	0
49	1976	1	1	0	0
50	1976	1	1	0	0

SAMPLE OF WILDLIFE DATABASE

	HEDONIC	OTHER	BENEFICIARIES
1	0	N/A	2
2	0	N/A	2
3	0	N/A	2
4	0	N/A	2
5	0	N/A	2
6	0	N/A	2
7	0	N/A	2
8	0	N/A	2
9	0	N/A	2
10	0	N/A	2
11	0	N/A	2
12	0	N/A	2
13	0	N/A	2
14	0	N/A	4
15	0	N/A	2
16	0	N/A	2
17	0	N/A	2
18	0	N/A	2
19	0	N/A	2
20	0	N/A	1
21	0	N/A	2
22	0	N/A	4
23	0	N/A	4
24	0	N/A	4
25	0	N/A	4
26	0	N/A	4
27	0	N/A	4
28	0	N/A	4
29	0	N/A	4
30	0	N/A	4
31	0	N/A	4
32	0	N.A	4
33	0	N/A	1
34	0	N/A	2
35	0	N/A	2
36	0	N/A	2
37	0	N/A	2
38	0	N/A	2
39	0	N/A	2
40	0	N/A	2
41	0	N/A	2
42	0	N/A	2
43	0	N/A	2
44	0	N/A	2
45	0	N/A	2
46	0	N/A	2
47	0	N/A	1
48	0	N/A	1
49	0	N/A	1
50	0	N/A	1

SAMPLE OF WILDLIFE DATABASE

	BENEFIT VALUE	1994 $
1	$72.00	$126
2	$70.00	$123
3	$68.00	$119
4	$63.00	$111
5	$53.00	$93
6	$55.00	$96
7	$107.00	$188
8	$52.00	$91
9	$67.00	$118
10	$81.00	$142
11	$7.00	$33
12	$9.00	$43
13	$4.00	$19
14	$12.00	$57
15	$4.00	$11
16	$4.00	$11
17	$7.00	$19
18	$14.00	$15
19	$30.00	$31
20	$256.00	$342
21	$123.00	$127
22	$92.00	$137
23	$99.00	$148
24	$50.00	$77
25	$22.00	$34
26	$17.00	$26
27	$35.00	$54
28	$26.00	$40
29	$90.00	$138
30	$28.00	$43
31	$19.00	$29
32	$38.00	$58
33	$4.00	$11
34	$3.00	$8
35	$45.00	$57
36	$71.00	$90
37	$193.00	$244
38	$275.00	$348
39	$96.00	$100
40	$70.00	$73
41	$18.00-$58.00	$19 - $60
42	$30.00-$137.00	$31 - $141
43	$210.00	$583
44	$164.00	$456
45	$123.00	$342
46	$250.00	$694
47	$16.00	$44
48	$10.00	$28
49	$10.00	$28
50	$18.00	$50

SAMPLE OF WILDLIFE DATABASE

	DENOMINATIONS	DEMOGRAPHICS	EXPENDITURES
1	3	1	1
2	3	1	1
3	3	1	1
4	3	1	1
5	3	1	1
6	3	1	1
7	3	1	1
8	3	1	1
9	3	1	1
10	3	1	1
11	3	1	1
12	3	1	1
13	3	1	1
14	3	1	1
15	3	1	1
16	3	1	1
17	3	1	1
18	7	1	0
19	7	1	0
20	4	1	1
21	7	1	1
22	4	0	1
23	4	0	1
24	4	0	1
25	4	0	1
26	4	0	1
27	4	0	1
28	4	0	1
29	3	N/A	N/A
30	3	N/A	N/A
31	3	N/A	N/A
32	3	N/A	N/A
33	3	1	0
34	3	1	0
35	7	1	1
36	7	1	1
37	7	1	1
38	7	1	1
39	5	1	1
40	5	1	1
41	4	1	1
42	4	1	1
43	7	1	1
44	7	1	1
45	7	1	1
46	7	1	1
47	3	1	1
48	3	1	1
49	3	1	1
50	3	1	1

SAMPLE OF WILDLIFE DATABASE

	TRIPS MADE	DISTANCE	DURATION	PARTY SIZE
1	1	1	1	1
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1
5	1	1	1	1
6	1	1	1	1
7	1	1	1	1
8	1	1	1	1
9	1	1	1	1
10	1	1	1	1
11	1	1	1	1
12	1	1	1	1
13	1	1	1	1
14	1	1	1	1
15	1	1	1	0
16	1	1	1	0
17	1	1	1	0
18	0	0	0	0
19	0	0	0	0
20	1	1	1	0
21	1	1	1	1
22	1	1	1	1
23	1	1	1	1
24	1	1	1	1
25	1	1	0	1
26	1	1	0	1
27	1	1	1	1
28	1	1	1	1
29	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A
31	N/A	N/A	N/A	N/A
32	N/A	N/A	N/A	N/A
33	0	1	1	1
34	0	0	1	1
35	1	1	1	1
36	1	1	1	1
37	1	1	1	1
38	1	1	1	1
39	1	0	1	0
40	1	0	1	0
41	1	1	1	1
42	1	1	1	1
43	1	1	1	1
44	1	1	1	1
45	1	1	1	1
46	1	1	1	1
47	1	1	1	1
48	1	1	1	1
49	1	1	1	1
50	1	1	1	1

SAMPLE OF WILDLIFE DATABASE

	SUBSTITUTE SITE	FAMILY INCOME	VALUE OF TIME
1	0	1	1
2	0	1	1
3	0	1	1
4	0	1	1
5	0	1	1
6	0	1	1
7	0	1	1
8	0	1	1
9	0	1	1
10	0	1	1
11	0	1	0
12	0	1	0
13	1	1	0
14	1	1	0
15	0	1	1
16	0	1	1
17	0	1	1
18	0	1	0
19	0	1	0
20	0	1	0
21	0	1	1
22	1	0	0
23	1	0	0
24	1	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	0	0
29	N/A	N/A	N/A
30	N/A	N/A	N/A
31	N/A	N/A	N/A
32	N/A	N/A	N/A
33	1	1	0
34	1	1	0
35	0	1	0
36	0	1	0
37	0	1	0
38	0	1	0
39	0	1	0
40	0	1	0
41	0	1	0
42	0	1	0
43	0	1	0
44	0	1	0
45	0	1	0
46	0	1	0
47	0	1	0
48	0	1	0
49	0	1	0
50	0	1	0

SAMPLE OF WILDLIFE DATABASE

	SURVEY USED	LICENSE FEE	LODGING	FOOD
1	3	N/A	$20/yr	$76/yr
2	3	N/A	$14/yr	$72/yr
3	3	N/A	$97/yr	$313/yr
4	3	N/A	$18/yr	$84/yr
5	3	N/A	$8/yr	$39/yr
6	3	N/A	$20/yr	$76/yr
7	3	N/A	$14/yr	$72/yr
8	3	N/A	$97/yr	$313/yr
9	3	N/A	$18/yr	$84/yr
10	3	N/A	$8/yr	$39/yr
11	3	$3	$9/yr	N/A
12	3	$3-$8	$4/yr	N/A
13	3	$6	$13/tr	$40/tr
14	3	$6	N/A	N/A
15	3	$7	N/A	N/A
16	3	$7	N/A	N/A
17	3	$7	N/A	N/A
18	3	N/A	N/A	N/A
19	3	N/A	N/A	N/A
20	1	N/A	N/A	N/A
21	3	N/A	N/A	N/A
22	2	N/A	$86/tr	$84/tr
23	2	N/A	$86/tr	$84/tr
24	3	N/A	N/A	N/A
25	2	N/A	N/A	N/A
26	2	N/A	$39/tr	$8/tr
27	2	N/A	N/A	N/A
28	2	N/A	$2/day	$10/day
29	N/A	$71	N/A	N/A
30	N/A	$71	N/A	N/A
31	N/A	$71	N/A	N/A
32	N/A	$71	N/A	N/A
33	1	N/A	N/A	N/A
34	3	N/A	N/A	N/A
35	3	N/A	N/A	N/A
36	3	N/A	N/A	N/A
37	3	N/A	N/A	N/A
38	3	N/A	N/A	N/A
39	3	N/A	N/A	N/A
40	3	N/A	N/A	N/A
41	3	N/A	N/A	N/A
42	3	N/A	N/A	N/A
43	3	$10	$9/yr	$40/yr
44	3	$7	$8/yr	$19/yr
45	3	$8	$9/yr	$20/yr
46	3	$13	$13/yr	$41/yr
47	3	N/A	N/A	N/A
48	3	N/A	N/A	N/A
49	3	N/A	N/A	N/A
50	3	$13	N/A	N/A

SAMPLE OF WILDLIFE DATABASE

	TRAVEL	MISC.	CAPITAL GOOD	VALUE
1	$179/yr	$23/yr	2	$26/yr
2	$146/yr	$44/yr	2	$24/yr
3	$652/yr	$170/yr	2	$63/yr
4	$200/yr	$33/yr	2	$29/yr
5	$103/yr	$6/yr	2	$11/yr
6	$179/yr	$23/yr	2	$26/yr
7	$146/yr	$44/yr	2	$24/yr
8	$652/yr	$170/yr	2	$63/yr
9	$200/yr	$33/yr	2	$29/yr
10	$103/yr	$6/yr	2	$11/yr
11	$73/yr	$17/yr	5	$19/yr
12	$25/yr	$10/yr	2	$15/yr
13	$43/tr	$18/tr	3	$3/tr
14	N/A	N/A	0	N/A
15	N/A	N/A	0	N/A
16	N/A	N/A	0	N/A
17	N/A	N/A	0	N/A
18	N/A	N/A	0	N/A
19	N/A	N/A	0	N/A
20	N/A	N/A	0	N/A
21	N/A	N/A	0	N/A
22	$92/tr	N/A	0	N/A
23	$92/tr	N/A	0	N/A
24	N/A	N/A	0	N/A
25	N/A	N/A	0	N/A
26	$30/tr	N/A	2	$8/tr
27	N/A	N/A	0	N/A
28	$12/day	N/A	2	$10/day
29	N/A	N/A	0	N/A
30	N/A	N/A	0	N/A
31	N/A	N/A	0	N/A
32	N/A	N/A	0	N/A
33	N/A	N/A	0	N/A
34	N/A	N/A	0	N/A
35	N/A	N/A	0	N/A
36	N/A	N/A	0	N/A
37	N/A	N/A	0	N/A
38	N/A	N/A	0	N/A
39	N/A	N/A	0	N/A
40	N/A	N/A	0	N/A
41	N/A	N/A	0	N/A
42	N/A	N/A	0	N/A
43	$66/yr	$4/yr	2	$12/yr
44	$37/yr	$5/yr	2	$14/yr
45	$46/yr	$5/yr	2	$30/yr
46	$78/yr	$7/yr	2	$30/yr
47	N/A	N/A	0	N/A
48	N/A	N/A	0	N/A
49	N/A	N/A	0	N/A
50	N/A	N/A	0	N/A

SAMPLE OF WILDLIFE DATABASE

	TOTAL EXPEND.
1	$376/yr
2	$431/yr
3	$1889/yr
4	$429/yr
5	$217/yr
6	$376/yr
7	$431/yr
8	$1889/yr
9	$429/yr
10	$217/yr
11	N/A
12	$69/yr
13	$239/yr
14	N/A
15	N/A
16	N/A
17	N/A
18	N/A
19	N/A
20	$224/tr
21	N/A
22	N/A
23	N/A
24	N/A
25	N/A
26	$39/tr
27	N/A
28	N/A
29	N/A
30	N/A
31	N/A
32	N/A
33	N/A
34	N/A
35	N/A
36	N/A
37	N/A
38	N/A
39	N/A
40	N/A
41	N/A
42	N/A
43	$153/yr
44	$101/yr
45	$120/yr
46	$194/yr
47	N/A
48	N/A
49	N/A
50	N/A